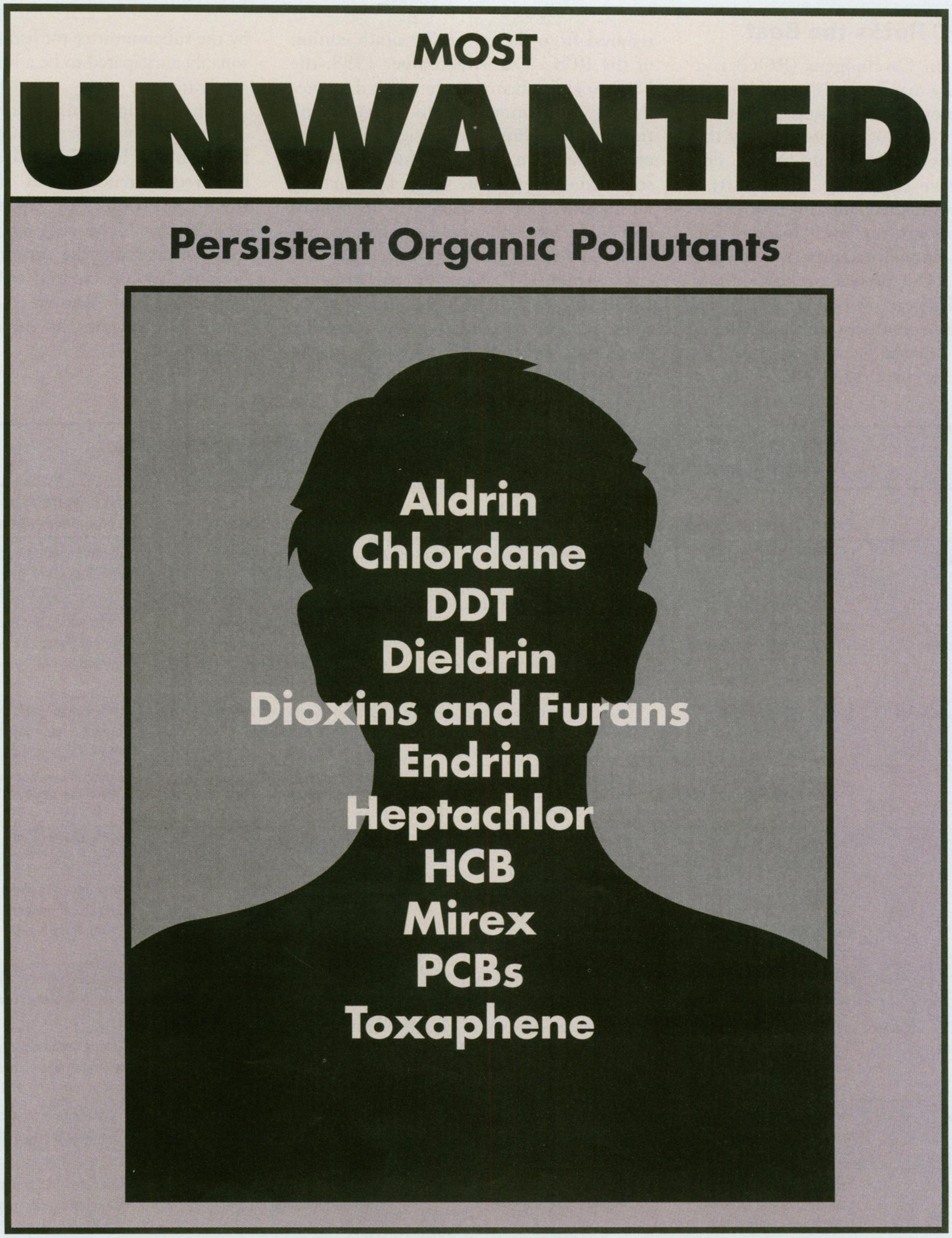


While many chemicals can enhance and even save lives by ensuring food security and protecting health, others aren't so beneficial. More specifically, a dozen chemical compounds have been identified by the United Nations Environment Programme (UNEP) as powerful threats to human and wildlife health on a global basis. These chemicals belong to a class known as persistent organic pollutants (POPs)—compounds that travel thousands of miles, accumulate in the food chain, and persist in the environment, taking up to centuries to fully degrade. It has been well documented that exposure to POPs can cause birth defects, various cancers, immune system dysfunction, and reproductive problems in wildlife.

Although the effects of POPs on human health are unclear, the weight of the evidence indicates that high levels of exposure over the long term may contribute to increasing rates of birth defects, fertility problems, greater susceptibility to disease, diminished intelligence, and some types of cancers in certain regions of the world. Of major concern for human health is the effect of exposure to POPs on the developing fetus. POPs can accumulate in human tissues and pass through the placenta to the fetus. Furthermore, POPs have been detected in the breast milk of women throughout the world. Little is known about the effect of long-term, low levels of exposure to POPs, but emerging evidence indicates that many POPs may act as endocrine disruptors.

In response to national and international concerns, UNEP assumed the lead in mounting the first international effort to control POPs on a global level. Initially, 12 POPs have been identified as requiring urgent attention. These chemicals, which have been dubbed "the dirty dozen," include aldrin, chlordane, DDT, dieldrin, dioxins, endrin, furans, heptachlor, hexachlorobenzene (HCB), mirex, polychlorinated biphenyls (PCBs), and toxaphene.

In February 1997, UNEP issued a formal decision calling for international action to reduce or eliminate the release of POPs into the environment. The decision includes the requirement of an international, legally binding instrument, which the organization plans to have in place by the year 2000. According to UNEP, global cooperation is necessary due to the long-range transport of POPs; no government acting alone can protect its citizens or environment from the threat of POPs. The chemicals are ubiquitous throughout the global environment—residues have been detected in Arctic human populations and wildlife, in regions far from where POPs are produced and released.

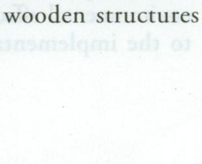
Properties of POPs

POPs are organic compounds that resist photolytic, biological, and chemical degradation. Most are semivolatile, which allows them to move long distances in the atmosphere before deposition occurs. POPs are transported across the globe by a process called the "grasshopper effect." This process, which is often seasonal, involves a repeated pattern of release of a chemical into the atmosphere, such as through evaporation, and its subsequent deposit elsewhere, such as through rainfall. Due to the persistent nature of POPs, the chemicals are spread widely throughout the world through numerous iterations of this cycle.

Many POPs are halogenated (that is, they contain one or more elements of the halogen family, which includes fluorine, chlorine, bromine, and iodine) and are characterized by low solubility in water and high solubility in lipids. These properties, combined with the chemicals' persistence, allows them to bioconcentrate and bioaccumulate in the fatty tissues of organisms. Bioconcentration refers to the uptake of a chemical directly from water into an aquatic organism, while bioaccumulation refers to the process of uptake from both water and dietary sources. These processes lead to biomagnification, in which tissue concentrations of a contaminant increase as it passes through two or more trophic levels in the food chain. Bioconcentration is measured as a ratio of the amount of a chemical concentrated in an organism compared to the amount of the chemical in the surrounding environment. For example, if the bioconcentration factor of a chemical in a fish is 5,000, then there is 5,000 times the amount of chemical in the fish as in the water.

Nine of the 12 POPs are pesticides used on agricultural crops and for public health vector control. PCBs are used for industrial purposes, while dioxins and furans are unintentional industrial by-products that have no known use. In the 1970s, many countries banned or severely restricted the use of all nine pesticides and PCBs, and implemented pollution controls to prevent the release of dioxins and furans. However, it is thought that all nine pesticides and PCBs are still used in many countries today. While there is some information available about the volume of worldwide POPs production, little is known about the specific uses for POPs in different countries and the actual quantities being used. Efforts to address these questions are currently underway by several organizations, including the Food and Agriculture Organization (FAO) of the United Nations, the United Nations Economic Commission for Europe, the World Bank, and UNEP.

At UNEP's request, the World Health Organization's (WHO) International Programme on Chemical Safety prepared a report that was published in December 1995 entitled *A Review of the Persistent Organic Pollutants: DDT, Aldrin, Dieldrin, Endrin, Chlordane, Heptachlor, Hexachlorobenzene, Mirex, Toxaphene, Polychlorinated Biphenyls, Dioxins, and Furans.* The report provides an extensive review of the literature, profiling each of the 12 POPs targeted for elimination. The following summaries provide an overview of the report's data on each chemical.



Aldrin. Aldrin is a pesticide used to control soil insects such as termites, grasshoppers, corn rootworm, wireworms, and rice water weevils. It has been widely used to protect crops such as corn and potatoes, and to protect wooden structures from termites.

In plants and animals, aldrin is readily metabolized to dieldrin, another of the 12 POPs targeted by UNEP. Because it is persistent and hydrophobic, aldrin has been found to bioconcentrate in animal tissues, mainly as dieldrin and its other conversion products.

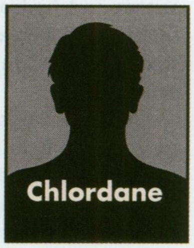
Aldrin is toxic to humans and is lethal to an adult male at a dose of about 5 g, equivalent to 83 mg/kg body weight (bw). Symptoms of aldrin intoxication include headache, dizziness, nausea, general malaise, and vomiting, followed by muscle twitching, myoclonic jerks, and convulsions. Research has suggested that occupational exposure to aldrin, in conjunction with dieldrin and endrin, may be associated with an increase in liver and biliary cancer. Aldrin may also affect the immune response.

The International Agency for Research on Cancer (IARC) concluded that aldrin is not classifiable in terms of its carcinogenicity in humans, as there is inadequate evidence of carcinogenicity in humans and limited evidence in animals.

Research has shown that reproductive effects occur in the offspring of pregnant rats dosed with 1.0 mg aldrin/kg bw subcutaneously. Offspring experienced a decrease in the median effective time for incisor teeth eruption and an increase in median effective time for testes descent, which indicates possible endocrine disruption. Residues of aldrin have been detected in birds, eggs, scavengers, predators, fish, frogs, invertebrates, and soil. It is thought that ingestion of rice treated with aldrin as well as the consumption of organisms contaminated with aldrin caused the deaths of waterfowl, shorebirds, and passerines along the Texas Gulf coast from 1967 to 1971. Aldrin residues have also been detected in fish in Egypt.

For humans, dairy products and meats are the primary sources of exposure to aldrin. In studies in Vietnam and India in 1992 on residues of persistent organochlorine compounds and their implications for human dietary exposure, researchers calculated that the average daily intake of both aldrin and dieldrin was 19 μg/person in India, which exceeds the provisional tolerable daily intake of 0.1 μg/kg bw recommended by the Joint FAO/WHO Meeting on Pesticide Residues (JMPR) in 1977. Aldrin has been banned in several countries, and is severely restricted in many others, such as Canada and the United States, as well as in the European Union.

Chlordane. Chlordane is a broad-spectrum contact insecticide used on agricultural crops including vegetables, small grains, maize, other oilseeds, potatoes, sugarcane, sugar beets, fruits, nuts, cotton, and jute. It has also been extensively used to control termites.

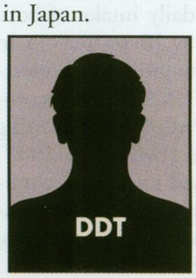


Chlordane binds readily to aquatic sediments and bioconcentrates in the fat of organisms. Data suggest that chlordane is bioconcentrated as opposed to being bioaccumulated. Bioconcentration factors of 37,800 for fathead minnows and 16,000 for sheepshead minnows have been reported. The half-life of chlordane in soil has been estimated to be approximately 1 year.

Significant changes have been reported in the immune systems of people who complained of health effects that they associated with chlordane exposure. While there is inadequate evidence of the carcinogenicity of chlordane in humans, there is sufficient evidence in experimental animals, and IARC has therefore classified chlordane as a possible human carcinogen.

In a 1968 study in which mice were fed diets containing 25–100 mg chlordane for six generations, researchers found that doses of 100 mg/kg bw caused decreases in viability in the first and second generations. The third generation produced no offspring. At doses of 50 mg/kg bw, viability was decreased in the third and fourth generations. At doses of 25 mg/kg bw, no statistically significant effects were observed.

Actions to ban the use of chlordane have been taken in many countries, and its use is severely restricted or limited to nonagricultural uses in several others. Because of these agricultural restrictions, food does not now appear to be a major pathway of human exposure. However, due to its continued use in termite control, exposure to chlordane in the air may be an important source of exposure for the U.S. population. Chlordane has been detected in the indoor air of residences in the United States and in Japan.



DDT. During World War II, DDT was used extensively to protect soldiers and civilians from malaria, typhus, and other diseases spread by insects. After the war, DDT was commonly used as a pesticide on a variety of agricultural crops, especially cotton. While much of the agricultural use has ceased, DDT is still being produced and used for vector control, particularly against mosquitoes that spread malaria.

DDT and related compounds are very persistent in the environment; up to 50% of an application can remain in the soil for 10–15 years. Bioconcentration factors of 154,100 for fathead minnows and 51,335 for rainbow trout have been reported. DDT has been detected in virtually all organochlorine monitoring programs and is believed to be ubiquitous throughout the global environment.

Some evidence suggests that DDT may suppress the immune system, and research shows that perinatal administration of weakly estrogenic pesticides such as DDT produces estrogen-like alterations of reproductive development. Limited data suggest a link between DDT and a risk of breast cancer. IARC has classified DDT as a possible human carcinogen, based on inadequate evidence of the carcinogenicity in humans, but sufficient evidence in experimental animals.

DDT is highly toxic to fish and can affect fish behavior. In one study, Atlantic salmon hatched from eggs exposed to DDT experienced impaired balance and delayed appearance of normal behavior patterns. DDT is also acutely toxic to birds, and received extensive publicity in the 1970s for its adverse effects on bird reproduction, causing eggshell thinning and adversely impacting reproductive success. DDT has also been linked with feminization and altered sex ratios of western gull populations off the coast of southern California and herring gull populations in the Great Lakes.

DDT and its metabolites have been detected in foods around the world, which is thought to be the primary route of human exposure. Residues in domesticated animals have declined steadily over the past 20 years, but in a 1989–1991 survey of Spanish meat and meat products, 83% of lamb samples contained at least one of the DDT metabolites being investigated. In a 1992 study in Vietnam, DDT was the most common organochlorine detected in foodstuffs, and the estimated daily intake of DDT and its metabolites was 19 µg/person/day. In India, the estimated daily intake has been found to be 48 µg/person/day for DDT and its metabolites. DDT has also been detected in human breast milk in Egypt and New Guinea. In a 1993 survey of compounds in the milk of lactating mothers in four remote villages in Papua New Guinea, DDT was detected in 100% of the samples.

Widespread concern about the adverse environmental effects of DDT contributed to the implementation of severe restrictions on its use in many developed countries. The use of DDT has been banned in at least 34 countries and severely restricted in 34 others.

Dieldrin. Dieldrin was traditionally used in agriculture in the control of soil insects, as well as in public health protection to control several insect vectors. Primary uses today include controlling termites, wood borers, and textile pests.

Its persistence, along with its high lipid solubility, allows dieldrin to bioconcentrate and biomagnify in organisms. In fish, bioconcentration factors of 12,500 for guppies and 13,300 for sculpins have been reported. Dieldrin residues have been detected in air, water, soil, and the tissue of fish, birds, and mammals, including humans and human breast milk. Because aldrin is converted to dieldrin in many organisms, the levels of dieldrin reflect the total concentrations of both compounds. Dieldrin binds strongly to soil particles and is therefore resistant to leaching into groundwater. The half-life of dieldrin in temperate soils is approximately 5 years.

In a study published in the 5 December 1998 issue of *The Lancet*, researchers at the Copenhagen Center for Prospective Population Studies in Denmark assessed the risk of breast cancer in women who had serum samples taken in 1976. They found that the risk of breast cancer was twice as high in women with the highest serum concentrations of dieldrin as that in women with the lowest concentrations, and a significant dose–response relation was apparent.

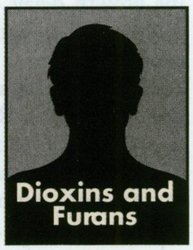
Dieldrin is toxic to humans, and the symptoms of intoxication are essentially the same as those for aldrin. There is limited evidence that cyclodienes—a class of organic insecticides that includes dieldrin—may affect immune responses. Because there is inadequate evidence that dieldrin is a carcinogen in humans and limited evidence in experimental animals, IARC concluded that dieldrin is not classifiable as to its carcinogenicity in humans.

In studies on rats, the liver has been the major target organ of dieldrin, as is the case with other organochlorine compounds. Effects include increased liver–bw ratio, hypertrophy, and histopathological changes.

Dieldrin has been found to be highly toxic to fish and frogs in laboratory studies. In embryo–larval tests on the *Xenopus laevis* frog, exposure to low concentrations of dieldrin resulted in spinal deformities after a 10-day exposure. In another study, white-tailed deer were fed a diet containing dieldrin for up to 3 years. While adult survival was not affected, fawns of treated does were smaller at birth and experienced greater postpartum mortality and diminished weight gain.

Food, especially dairy products and animal meats, is the primary source of human exposure to dieldrin. Dieldrin was the second most common pesticide detected in a survey of U.S. pasteurized milk published in 1993. Dieldrin has also been detected in Spanish meat, with residues found in the fat of 8–15% of pork products and in 28% of poultry sausage. Action to ban dieldrin has been taken in many countries, and numerous others have restricted its use.

Dioxins and furans. Dioxins and furans are two groups of planar tricyclic compounds that have similar chemical structures and properties. There are a total of 210 dioxins and furans. Dioxins are released as an incineration by-product in the production of pesticides and other chlorinated substances, while furans are a major contaminant of PCBs. Both have been detected in emissions from the incineration of hospital waste, municipal waste, hazardous waste, car emissions, and the burning of coal, peat, and wood. Dioxins and furans are lipophilic, insoluble in water, and highly persistent in the environment. Both have been detected in Arctic organisms.

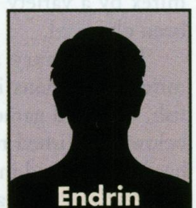


The only persistent human health effect clearly associated with exposure to dioxins is chloracne, a skin condition resembling acne caused by exposure to chlorinated hydrocarbons. Other reported health effects include peripheral neuropathies, fatigue, depression, personality changes, hepatitis, enlarged liver, abnormal enzyme levels, and porphyria cutanea tarda, a disorder characterized by liver dysfunction and photosensitive cutaneous lesions. However, no causal relationships for dioxins have been established for these effects. In a 1991 study of 1,520 workers known to have been exposed to 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) for at least 1 year and with a latency of at least 20 years between exposure and diagnosis of disease, a slight but significantly elevated mortality from soft tissue sarcoma and cancers of the respiratory system was identified. IARC has classified 2,3,7,8-TCDD as a possible human carcinogen. Other dioxins are currently deemed not classifiable by IARC as to their carcinogenicity in humans.

Common effects of dioxin exposure on animals include wasting, hepatotoxicity, chloracne, epidermal changes, and gastric lesions. In both male and female rats, dioxins are associated with adverse effects on the reproductive systems. Effects in males include altered regulation of luteinizing hormone secretion, reduced testicular steroidogenesis, reduced plasma androgen concentrations, reduced testis and accessory sex organ weights, abnormal testis morphology, decreased spermatogenesis, and reduced fertility. Effects in females include hormonal irregularities in the estrous cycle, reduced litter size, and reduced fertility. In a 1988 study on fish, exposure to dioxins and furans caused delayed mortality and behavioral changes such as lethargic swimming, feeding inhibition, and lack of response to external stimuli. Fish in early life stages are extremely sensitive to dioxins and furans.

Food of animal origin is the primary source of human exposure to dioxins and furans. The release of dioxins and furans into the environment can be eliminated through the establishment of pollution controls. Such controls have been implemented in many developed countries, which has resulted in a significant reduction in the production of dioxins and furans.

Endrin. Endrin is a foliar insecticide used mainly on field crops such as cotton and grains. It is also used as a rodenticide to control mice and voles.



Endrin is rapidly metabolized by animals and does not accumulate in fat to the same extent as other compounds with similar structures. It enters the atmosphere by volatilization, and can contaminate surface water from soil runoff. The half-life of endrin in soil may be up to 12 years, depending on local conditions.

Endrin is toxic to humans. Symptoms of mild intoxication include dizziness, weakness of the legs, abdominal discomfort, and nausea, while more severe poisoning results in repeated, violent, epileptiform convulsions lasting several minutes, followed by semiconsciousness or coma. Limited evidence suggests that endrin may depress the immune response. IARC determined that endrin is not classifiable in terms of its carcinogenicity in humans.

Endrin is highly toxic to fish, with most LC50 values—indicating the concentration required to kill 50% of the test organisms—below 1.0 µg/L. One study exposed two groups of sheepshead minnow embryos to 0.31 and 0.72 µg/L for 23 weeks. All hatched early. Those exposed at 0.31 µg/L experienced stunted growth, and some died, while all those exposed to 0.72 µg/L died by the ninth day.

The main source of human exposure to endrin is food, but it is thought that the current intake is usually below the acceptable daily intake recommended by the JMPR. Recent monitoring data are not available, because most recent food surveys have not included endrin. The use of endrin has been banned in several countries and severely restricted in many others.

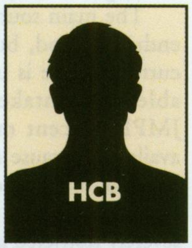
Heptachlor. Heptachlor is a nonsystemic stomach and contact insecticide, used primarily against soil insects and termites, as well as against cotton insects, grasshoppers, some crop pests, and malarial mosquitoes.

Heptachlor is metabolized in animals to heptachlor epoxide, the toxicity of which is similar to that of heptachlor. Heptachlor is insoluble in water, soluble in organic solvents, and highly volatile. It binds readily to aquatic sediments and bioconcentrates in the fat of organisms. Bioconcentration factors of 9,500 and 14,400 have been detected in fathead minnows for heptachlor and heptachlor epoxide, respectively. The half-life of heptachlor in soil is up to 2 years.

A 1992 study of workers from a plant that produced heptachlor and endrin found a significant increase in bladder cancer, but the small number of deaths makes interpretation of the findings difficult. IARC has classified heptachlor as a possible human carcinogen.

Symptoms of heptachlor poisoning in animals include tremors and convulsions. Heptachlor has been strongly implicated in the population declines of several wild birds, including Canadian geese and the American kestrel in the Columbia River Basin in the United States. Canadian geese at the Umatilla National Wildlife Refuge in Oregon experienced adult mortality and decreased reproductive success as a result of exposure to heptachlor. American kestrels have also experienced reduced reproductive success. Researchers determined that heptachlor-treated seeds were the route of exposure for the geese. Residues of heptachlor epoxide were detected in the brains of dead kestrels as well as in the eggs of some nests, indicating that heptachlor is transferred through the food chain, because kestrels are not seed-eaters.

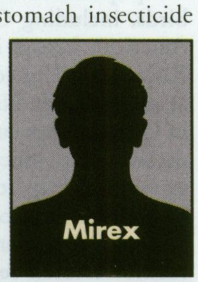
In a 1990 survey, heptachlor was detected in the blood of U.S. and Australian cattle, and was the most frequently detected organochlorine in both species. Heptachlor has been banned in several countries and severely restricted in others.



HCB. HCB is a fungicide that was introduced in 1945 for seed treatment, particularly for the control of bunt, a fungal disease of cereal grasses such as wheat and rye. HCB is also a by-product of the manufacture of industrial chemicals including carbon tetrachloride, perchloroethylene, trichloroethylene, and pentachlorobenzene. It is also a known impurity in several pesticide formulations.

The best documented episode of human exposure to HCB was the ingestion of HCB-treated seed grain in Turkey from 1954 to 1959. People who ingested the grain experienced photosensitive skin lesions, hyperpigmentation, hirsutism, colic, severe weakness, porphyrinuria, and debilitation. An estimated 3,000–4,000 people developed porphyria turcica, a disorder of heme biosynthesis, and mortality reached 14%. Pregnant women who ingested the grain passed HCB to their children via placental transfer and breast milk. These children developed "pembe yara" (or "pink sore," a disorder characterized by pink cutaneous lesions) and many had fevers, diarrhea, vomiting, weakness, convulsions, enlarged livers, and progressive wasting. At least 95% of these children died within a year of birth. Twenty years after the exposure, a study of 32 people showed that porphyria persisted for years after ingestion of HCB. IARC has classified HCB as a possible human carcinogen.

HCB is banned in many countries, and its use has been severely restricted or voluntarily withdrawn in several others.



Mirex. Mirex is a stomach insecticide with little contact activity that has been used primarily to control fire ants in the southeastern United States. It has also been used to control leaf cutters in South America, harvester termites in South Africa, western harvester ants in the United States, and mealybugs in Hawaii. Mirex has also been used industrially as a fire retardant in plastics, rubber, paint, paper, and electrical products.

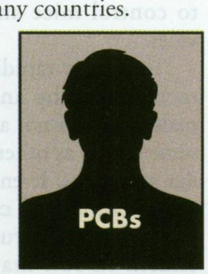
Mirex is insoluble in water, causing it to bind strongly to aquatic sediments, and to bioconcentrate and biomagnify. Bioconcentration factors of 2,600 in pink shrimp and 51,400 in fathead minnows have been reported. Mirex is one of the most stable and persistent pesticides, with a half-life of up to 10 years.

No injuries to humans resulting from mirex exposure have been documented. Mirex residues have been detected in human adipose tissue. IARC classifies mirex as a possible human carcinogen due to sufficient evidence of carcinogenicity in experimental animals.

In studies on rats, short-term effects of mirex administered orally include decreased body weight, hepatomegaly, induction of mixed-function oxidases, and morphological changes in liver cells. Feeding rats 5 ppm mirex for 30 days prior to mating and for 90 days after resulted in reduced litter size and increased parental mortality. Aquatic organisms, particularly crustaceans, are sensitive to mirex. Mirex is also toxic to fish and can affect fish behavior.

In several plant species, a reduction in germination and emergence has been associated with increases in concentrations of mirex. While the results are unclear, uptake, accumulation, and translocation of mirex by a variety of plant species has also been observed.

The primary source of exposure to mirex in humans is food, especially meat, fish, and wild game, but intake is generally below established residue tolerances. Mirex has been banned in many countries.

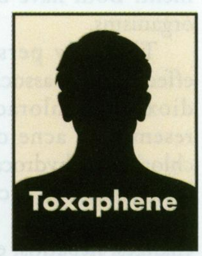


PCBs. PCBs are mixtures of chlorinated hydrocarbons that have been used extensively since 1930 for a variety of industrial uses, including as dielectrics in transformers and large capacitors, as heat exchange fluids, as paint additives, in carbonless copy paper, and in plastics. There are 209 possible PCBs.

PCBs in the environment may associate with organic components of soils, sediments, and biological tissues, or with dissolved organic carbon in aquatic systems. The properties of PCBs—including low water solubility, high stability, and semivolatility—favor long-range transport, and PCBs have been found in Arctic air, water, and organisms.

Symptoms of exposure include enlargement and hypersecretion of the Meibomian glands of the eyes, swelling of the eyelids, and pigmentation of the nails and mucous membranes, as well as occasional signs of fatigue, nausea, and vomiting. Subsequent symptoms include hyperkeratosis and darkening of the skin with follicular enlargement and acneform eruptions, along with secondary staphylococcal infection. IARC classifies PCBs as probable human carcinogens due to sufficient evidence in experimental animals.

The main source of human PCB exposure is through food, especially fish. Many people were exposed to PCBs through contaminated rice oil in Japan in 1968 and Taiwan in 1979. Children born within seven years to mothers exposed in Taiwan experienced hyperpigmentation, deformed nails and natal teeth, intrauterine growth delay, poorer cognitive development up to age seven, and behavioral problems. These children appeared to catch up developmentally to control children by age 12. Researchers believe these effects were a result of the persistence of PCBs in the human body, which allowed for prenatal exposure long after initial exposure occurred. This is consistent with other reports of poor short-term memory functioning in early childhood, such as that observed in 1990 in children exposed prenatally to PCBs through the mothers' high consumption of Lake Michigan game fish containing PCBs and other POPs. Recent evidence suggests that persistent halogenated aromatic hydrocarbons such as PCBs may also be linked to reproductive and immunotoxic effects in wildlife. PCBs have been phased out in many countries.



Toxaphene. Toxaphene is a nonsystemic contact insecticide that was introduced in 1949, and became the most widely used insecticide in the United States by 1975. It has been used primarily on cotton, cereal grains, fruits, nuts, and vegetables, as well as to control ticks and mites in livestock. Toxaphene is highly insoluble in water and its half-life in soil ranges up to 12 years, depending on soil type and climate, resulting in a tendency for it to bioconcentrate. Bioconcentration factors of 4,247 in mosquito fish and 76,000 in brook trout have been detected. Toxaphene's properties favor long-range transport, and it has been detected in Arctic air.

In a 1974 study, eight women working in an area that had been sprayed with toxaphene at a rate of 2 kg/ha had a higher incidence of chromosome aberrations (acentric fragments and chromatid exchanges) than in control individuals. IARC classifies toxaphene as a possible human carcinogen.

In a study using beagles, ingestion of 5.0 mg toxaphene/kg bw for 13 weeks resulted in increases in liver–bw ratio and serum alkaline phosphatase. Mild to moderate dose-dependent histological changes were observed in the liver and thyroid. Toxaphene is highly toxic to some fish, causing effects such as reduction in weight and reduction in egg laying, hatching ability, and viability.

The primary route of exposure is through food, but levels are generally below acceptable limits. Because it has been banned in at least 37 countries, recent food surveys have excluded toxaphene, and therefore, recent monitoring data are unavailable.

POPs Alternatives

Alternatives are available for most of the 10 POPs that are used commercially. Most of these alternatives are other chemicals to be used alone or in combination with biological controls.

DDT is one of the most controversial POPs as far as being replaced goes because of its use in controlling the spread of malaria, of which there are approximately 300–500 clinical cases annually, according to the WHO. A 1998 report by the World Wildlife Fund entitled *Resolving the DDT Dilemma* outlines what it says are affordable alternatives to DDT that still address the urgent need to combat malaria. These alternatives include pesticide-impregnated bed nets (reducing the need for interior spraying), odor-baited cloth targets to attract and destroy disease-carrying insects, lower-risk pesticides used in rotation to avoid the development of resistance, widespread elimination of mosquito breeding grounds, and introduction of natural predators and sterile insects.

There are many challenges to surmount in addressing the issue of alternatives to POPs. One of the largest problems for developing countries is cost—many of the alternatives are more expensive than the POPs they replace. In addition, the health effects of the alternative chemicals are still unclear; some are thought to be more acutely toxic and perhaps more hazardous to the user than some of the POPs. Furthermore, educating and training individuals around the world on the hazards of POPs and the uses of alternatives will be a massive undertaking.

In order to develop plans to implement the use of alternatives, officials first need to gain a better understanding of the current status of POPs. More information is needed about which countries are still using POPs, how they are using the chemicals, and in what quantities.

UNEP is developing a comprehensive inventory of the global manufacture, use, and disposition of POPs that should be available early this year. The inventory will be primarily based on country responses to a UNEP questionnaire and will also include data from other FAO, WHO, and UNEP projects, such as data on stockpiles of pesticides and other chemicals. The data will be used as a basis for a "clickable" world map on the POPs home page located at **http://irptc.unep.ch/pops/default.html.** Fatoumata Keita-Ouane, Scientific Affairs Officer for UNEP Chemicals in Geneva, Switzerland, explains: "The system enables the user to click on a country and view data relevant to that country. It also enables the user to select substances or data types to view, and to view a map that is color-coded or shaded by country to indicate the quantity for any parameter selected (e.g., DDT stocks, dioxin emissions, chlordane imports, etc.)." Ouane says the report and the map should be finalized by February 1999.

Brandy E. Fisher